Lecture Module - Electrical Signals

ME3023 - Measurements in Mechanical Systems

Mechanical Engineering

Tennessee Technological University

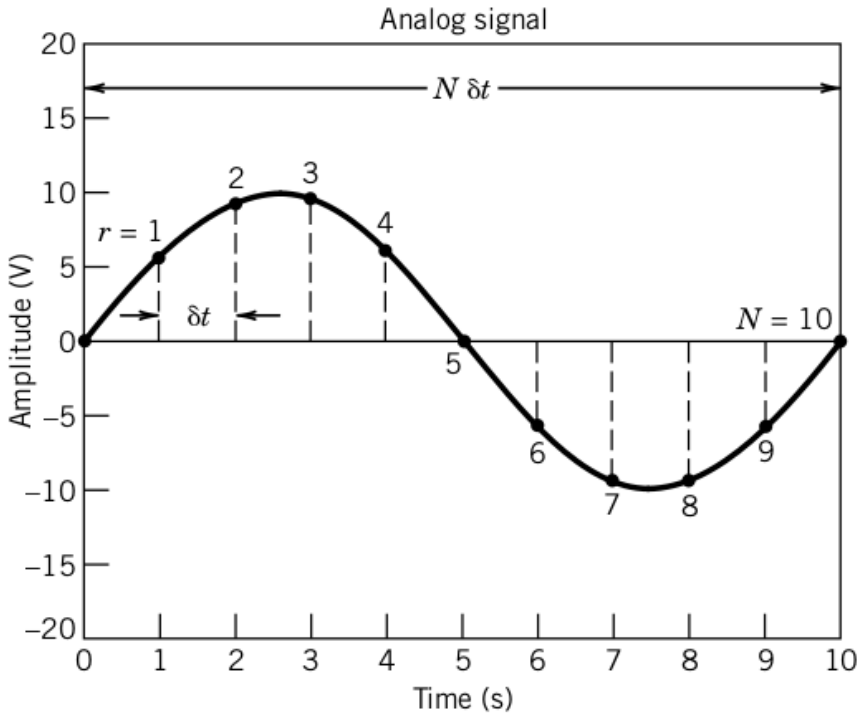
Topic 3 - Sampling and Aliasing

Topic 3 - Sampling and Aliasing

- Sampling
- The Aliasing Phenomenon
- Example by Hand
- MATLAB Example
- Activity

Sampling

... A discrete time signal usually results from the sampling of a continuous variable at repeated finite time intervals. ...



Discrete time signal $\{y(r\delta t)\}$	
r	Discrete data
0	0
1	5.9
2	9.5
3	9.5
4	5.9
5	0
6	−5.9
7	−9.5
8	−9.5
9	−5.9
10	0

Text,Figure: Theory and Design for Mechanical Measurements Ch. 7

Sampling

some reference

The Aliasing Phenomenon

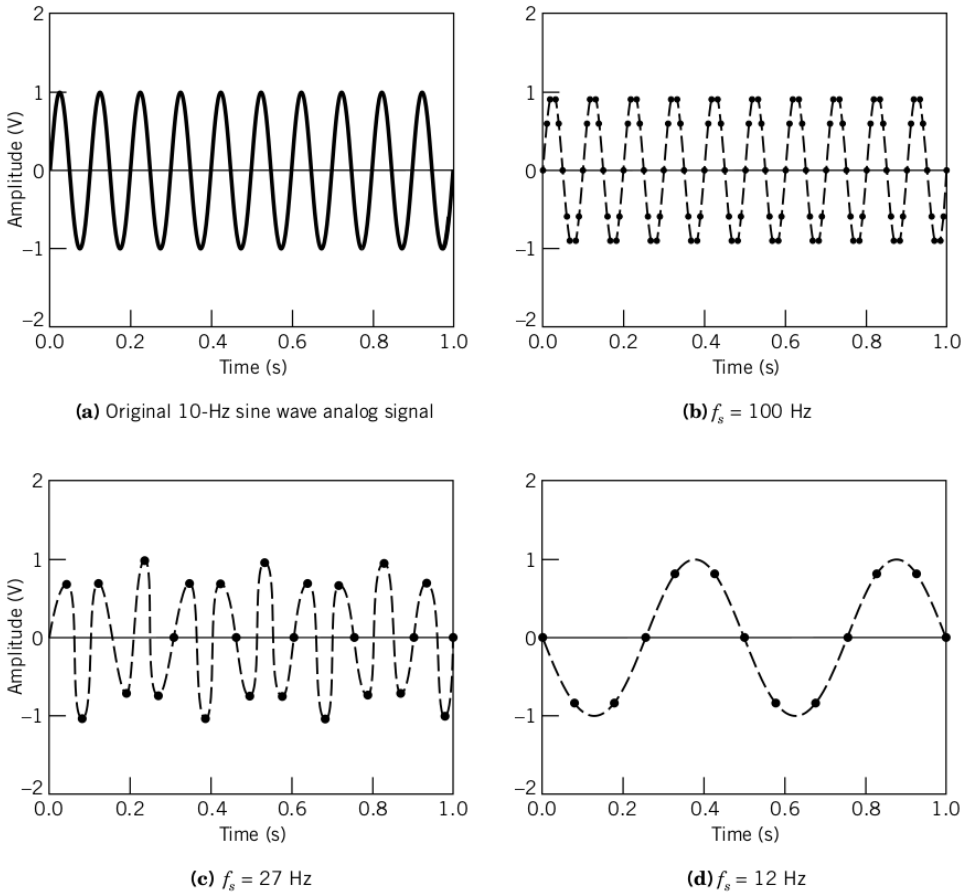


Figure: Theory and Design for Mechanical Measurements Ch. 7

Example by Hand

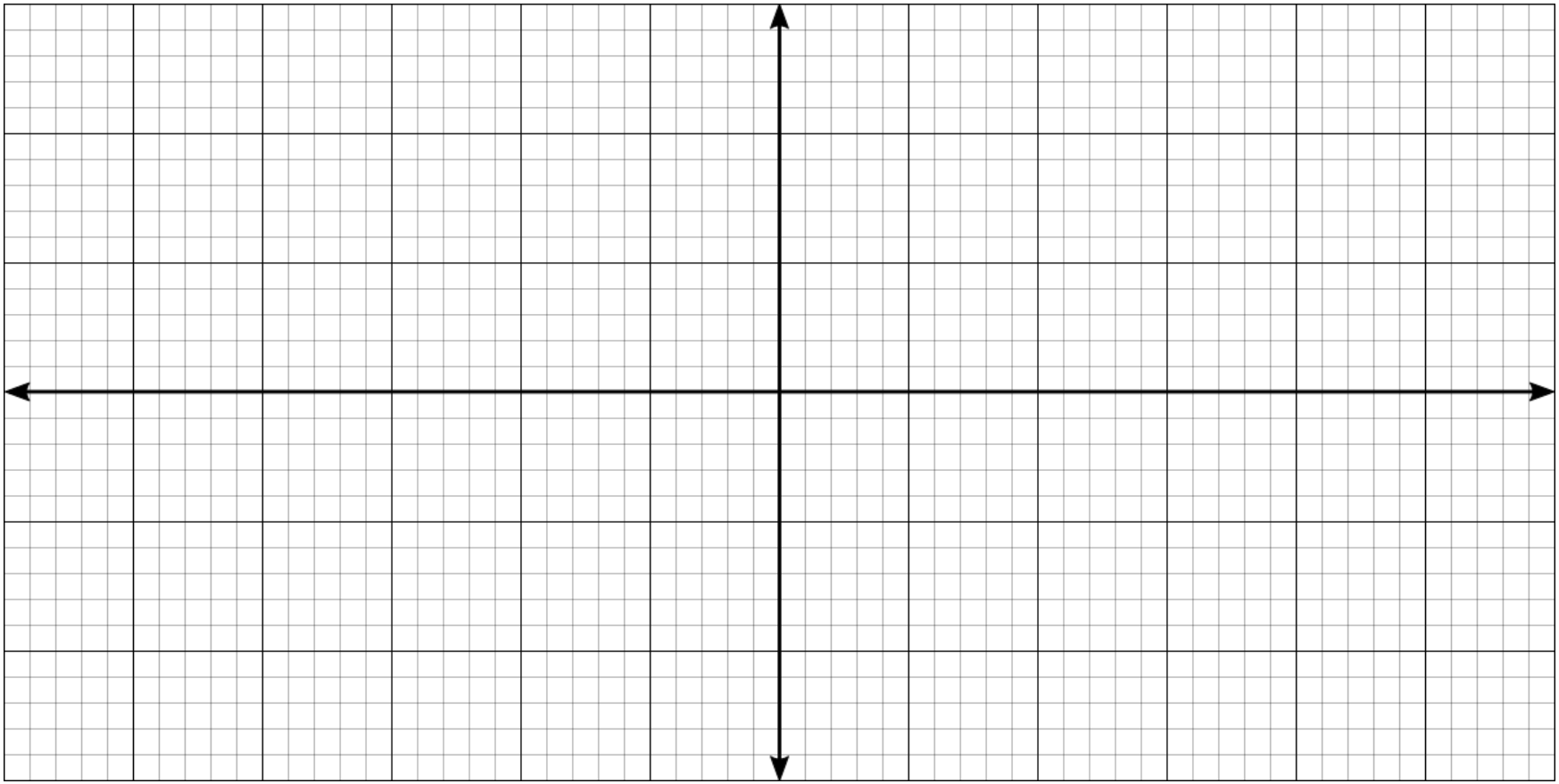


Image: T.Hill

Example by Hand

some reference

MATLAB Example

```
% ME3023 - Tennessee Technological University
% Tristan Hill - October 10, 2019 - April 14, 2021
% Data Acquisition Topic 3 - Sampling and Aliasing

clear variables; close all; clc

% simulate a continuous signal
A1=5; f1=3;
w1=2*pi*f1;

dt_sim=0.001; t_stop=6;
t_sim=0:dt_sim:t_stop;
y_sim=A1*sin(w1*t_sim);
```

MATLAB Example

```
% simulate sampling the signal
dt_sam = 0.3;
t_sam=0:dt_sam:t_stop;
y_sam=A1*sin(w1*t_sam);

% show the figure
figure(1); hold on
plot(t_sim,y_sim,'-',t_sam,y_sam,'o')
axis([0 t_stop -1.2*A1 1.2*A1])
grid on
```

MATLAB code: T. Hill

Activity

Activity: Sampling Demonstration
Write a MATLAB program to accomplish the following:

1. Plot a sinusoidal signal $y(t) = A\sin(\omega \cdot t) = A\sin(2\pi f \cdot t)$ with an amplitude $A = 10$ (units) and frequency $f = 1000$ (Hz). This is the *ideal signal* source.
   - Include axis labels and gridlines.
   - Choose ampitude and time scales so that 15 to 20 periods or the waveform are shown.

2. Simulate the samping of the signal by plotting the same function with a reduced time step. Plot the sampled signal on the same figure. Use a different marker and include a legend to differentiate the signals.

3. Use your code to determine the minimum sampling frequency required to measure the following quantities (note: use the sampled signal only, the *ideal signal* is not accessible).
   - Frequency of the *ideal signal*
   - Amplitude of the *ideal signal*

Deliverables: Submit your MATLAB code to the appropriate ilearn folder. If you work with a partner, include all names in the code. All group members must submit the assignment.